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Diet and egg production of the copepod *Acartia tonsa* in Florida Bay. II. Role of the nutritional environment

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**Abstract** As part of an ongoing study of changes in the trophic pathways of Florida Bay’s pelagic ecosystem, the nutritional environment (seston protein, lipid and carbohydrate levels), diet (taxon-specific microplankton ingestion rates) and egg production rate of the important planktonic copepod *Acartia tonsa* were measured off Rankin and Duck Keys in July and September 1997 and in January, March and May 1998. Rankin Key has been the site of extensive sea grass mortality and persistent ultraplankton blooms since 1987. Duck Key has experienced neither of these perturbations. Protoplus (autotroph) biomass was approximately twice as high off Rankin as off Duck Key. Diatoms, dinoflagellates and heterotrophic protists dominated the food environment off Rankin Key, while cells <5 μm diam often predominated off Duck Key. Protein and carbohydrate concentrations were higher off Rankin Key than Duck Key, while average lipid levels were usually low at both stations. Ingestion rates at both stations frequently approached temperature- and food-dependent maxima for the species, exceeding 100% of estimated body C d\(^{-1}\) on 3 of 5 occasions off Rankin Key. Egg production rates, however, were consistently low (Rankin: 3 to 16 eggs copepod\(^{-1}\) d\(^{-1}\); Duck: 1 to 12 eggs copepod\(^{-1}\) d\(^{-1}\)), and gross egg production efficiencies (100% × egg production C/ingested C) averaged <10%. At Duck Key, egg production rate varied with temperature and food concentration, while off Rankin Key, egg production was strongly correlated with seston protein content. The efficiency with which lipids (which were scarce in the seston) were transferred from the diet to the eggs increased exponentially with decreasing seston lipid content. Egg production efficiencies based on protein, however, were independent of seston protein content and never exceeded 10%.

**Introduction**

Florida Bay is a shallow, lagoonal estuary, located at the southern tip of the Florida peninsula, between the Gulf of Mexico and the Atlantic Ocean (Fig. 1). The Florida Keys tract represents a permeable boundary between Florida Bay and the Atlantic Ocean. There is no land boundary with the gulf. The bay is composed of numerous shallow (<1 to 3 m deep) basins bordered by mangrove islands, small keys, and sand and mud banks (Kleppel 1996). The Everglades is, historically, the primary freshwater source to Florida Bay, but channelization and water diversion during the past century have drastically altered freshwater flows (Boesch et al. 1993).

During the 1970s, Florida Bay was described as a clear, subtropical estuary with submersed vegetation dominated by sea grasses that supported a diverse, epibenthic, invertebrate fauna (Zieman et al. 1984; Fourquean et al. 1992; Kleppel 1996). However, in 1987, extensive sea grass mortality and persistent cyanobacteria and diatom blooms occurred in the central and inner reaches of the bay. These perturbations have continued to the present.

The shift in dominance among primary producers from the benthos (sea grasses) to the water column (phytoplankton) has stimulated considerable interest in how the trophic dynamics of the bay have changed since 1987. As part of a larger effort to understand the causes and implications of environmental change in Florida
Bay, we have been studying the diet and egg production of *Acartia tonsa*, the biomass-dominant planktonic copepod species in Florida Bay (P. Ortner personal communication). Previous studies revealed that egg production rates of *A. tonsa* were low and independent of temperature in most parts of the bay (Burkart 1998; Kleppel et al. 1998b). Highest egg production rates by *A. tonsa* in Florida Bay occurred when heterotrophic protists were a significant part of the diet (Kleppel et al. 1998b). Although it is interesting that a certain taxonomic group of food organisms was associated with elevated egg copepod production (see also Stoecker and Egloff 1987), taxonomic characterization cannot explain a physiological outcome, such as enhanced egg production. Rather, some attribute of the taxon, such as its nutritional value or its contribution to the overall nutritional quality of the seston, is probably responsible for